FHWA Exploratory Advanced Research (EAR) Program

Congestion Pricing Experiments and the Effects on Driver Choices

When and why drivers choose a tolled facility versus an untolled but congested parallel route is the subject of a 3-year project funded by the Federal Highway Administration's (FHWA) Exploratory Advanced Research (EAR) Program, in partnership with the University of Central Florida (UCF) and Georgia State University (GSU). The EAR Study, "Behavioral Sciences Approach to Testing, Validating, and Establishing Best Practices for Alternative Highway Revenue Collection: Experiments on Driving Under Uncertain Congestion Conditions and the Effects on Traffic Networks from Congestion Pricing Initiatives," examines how driver risk-preferences influence choices of route and travel departure times.

Background

Understanding driver reaction to congestion pricing has been limited, partly because data are commonly collected via simple surveys that ask for intended responses to proposed congestion pricing. These surveys lack clear incentives for respondents to answer truthfully and accurately. Although the surveys are useful for some purposes, these methods are known to generate biased and unpredictable responses.[1]

This study used experimental economics to observe choices with precise monetary incentives. The participant pool was drawn from drivers in Orlando, FL, and Atlanta, GA. Participants received travel options with travel time and financial consequences. The overall objective of the study is to understand why drivers change their route choices when tolls change. A particular focus is the extent to which responses differ depending on varying preferences and perceptions of travel times and travel time reliability. Many of the instruments and procedures used in this study represent new methods of generating behavioral data on policy issues.

The researchers assessed responses to several congestion pricing schemes. Three basic types of experiments were conducted: (a) a field experiment in which global positioning system (GPS) instruments was used, (b) a multidriver traffic simulation experiment, and (c) a single-driver simulator experiment. The field experiment and the single-driver simulator experiments were individual choice experiments with no interactions among participants. The multidriver traffic simulator was a group experiment: The traffic conditions were generated by the simultaneous, but independent, choices of the participants.

Experimental Economics Tool

Researchers in the field of experimental economics, as well as in the closely related field of cognitive psychology, use laboratory experiments and field observations to understand complex, naturally occurring market systems and choices. The market system in this research is route choice and understanding why people choose priced versus non-priced travel routes. Studies of the State Route 91 (SR 91) in California have shown that income level is not the only determining factor in why people

[1] Cummings, R. G., Harrison, G. W., & Rutstrom, E. E. (1995, March). Homegrown Values and Hypothetical Surveys: Is the Dichotomous Choice Approach Incentive Compatible? *American Economic Review, 85*(1), 260–266. The authors compare willingness-to-pay responses in a purely hypothetical survey-type setting to one in which respondents have actual monetary consequences. The finding is a significant inflation in the stated willingness to pay in the survey setting.

choose a priced versus non-priced route. For example, 42 percent of commuters use SR 91's priced lanes, and few commuters are everyday users. The UCF and GSU study researchers are examining the role of risk preferences and travel time perceptions in route choice. A route choice represents a type of lottery with an expected payoff (travel time) and costs (toll versus non-toll).

Field Experiments

The researchers are studying drivers in four regions: an east and west side commuter route in Orlando, FL, and a northeast and northwest commuter route in Atlanta, GA. Researchers outfitted participant cars with a GPS device that receives but does not send signals, allowing researchers to collect information on driving habits. Each driver had a choice between taking two parallel 5-mile routes—an expressway and a local route—during the morning or evening commute. During the first 2-week drive period, each driver was paid a fixed fee for each valid recorded drive, up to a maximum of 20 drives. The subsequent two-drive periods involved additional surcharges and subsidies that varied by route. These incentives varied across drivers and driver periods, but each driver faced the same net incentive during each drive period.

Lab Experiments

The simulator driving tasks involved driving a car in a computer simulation and choosing among various routes to get from the origin to the destination. The participant's payment from the researchers depended on the travel time and on the choice between a tolled and a non-tolled, but congested, route. The same drivers who participated in the GPS-enabled-commuter study were involved with the simulator driving tasks. These tasks assess the risk attitudes of drivers and any characteristic biases in how they form beliefs about travel time experiences. In all of these tasks, the consequences are real money, not just hypothetical payments. In addition, participants responded to a socio-demographic questionnaire, an opinion questionnaire about congestion policies, and a traffic survey about their driving habits and congestion experiences. Together, the field and lab data will be used to model how driver characteristics interact with each other to determine the use of tolled routes.

Status

Over 550 drivers in Atlanta, GA, and Orlando, FL, completed the experiments. In addition, 210 college students participated in testing whether college student behavior can predict field driver behavior. Route choice, both in the field and in the driving simulator, was characterized by downward sloping demand curves. Risk attitudes are important determinants to route choice, and preliminary analysis of the data shows comparability of risk attitudes across tasks as well as regions and that college students behave similar to field drivers. There were some differences in behavior at the beginning of the experimental tasks, for example students were less risk averse in the driving simulator and field participants were initially more pessimistic than students in the lottery task; but these differences disappeared with very minimal experience. The researchers found evidence of risk aversion as captured both by sensitivity over values of route choices and by pessimism over likelihoods of congestion. As a result, although this implies that information of risk attitudes should improve predictions of route choices in transportation planning, it also shows that using cheaper subject pools (e.g., students instead of commuters) and elicitation instruments (e.g., lotteries instead of simulators) may be sufficient when conducting such studies. In December 2011, this research received a positive peer review from academics in the areas of experimental economics and road pricing at an FHWA-organized workshop. Looking ahead, this research will seek to understand demand elasticity related to tolls and congestion, as well as the potential for revenue- or welfare-maximizing tolls.

The study anticipates academic articles, and a "how to" guide for practitioners will be available around spring 2014. In the meantime, the team will conduct outreach events at the Transportation Research Board (TRB) Congestion Pricing Conference (Seattle, 2013), Economic Sciences Association (Santa Cruz, 2013), and TRB Annual Meeting (January 2014).